

# CAST



## CZ80CPU

### 8-Bit Microprocessor Core

The CZ80CPU implements a fast, fully-functional, single-chip, 8-bit microprocessor with the same instruction set as the Z80.

The core has a 16-bit address bus capable of directly accessing 64kB of memory space. It has 252 root instructions with the reserved 4 bytes as prefixes, and accesses an additional 308 instructions.

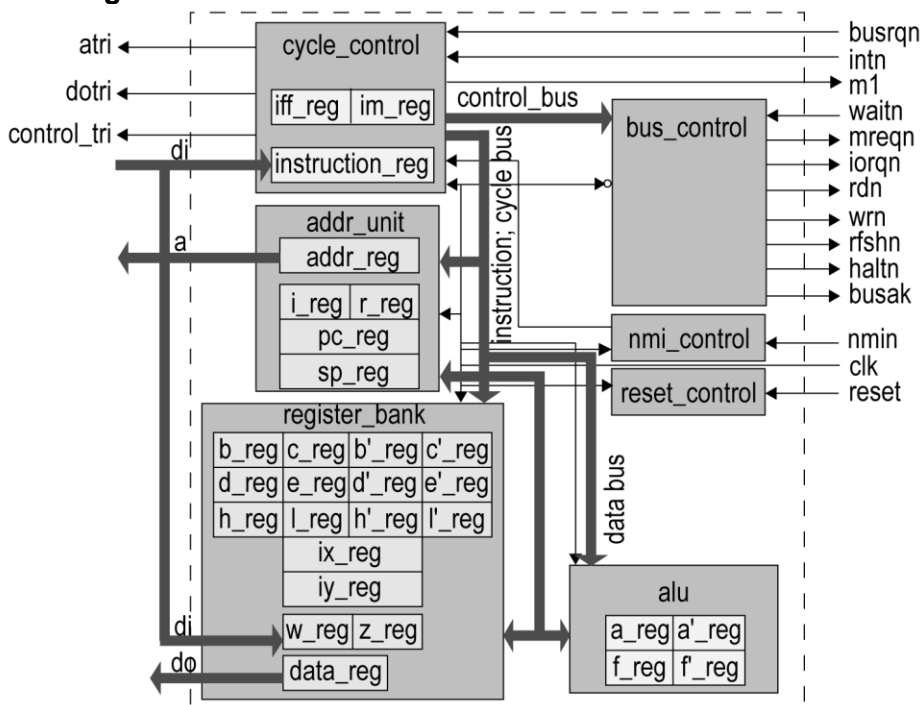
The microcode-free design was developed for reuse in ASIC and FPGA implementations. It is strictly synchronous, with no internal tri-states and a synchronous reset.

### Applications

The CZ80CPU is suitable for many embedded controller applications, including:

- industrial control systems
- point-of-sale terminals
- automotive controls

### Block Diagram



### Features

- Programming features contain 208 bits of read/write memory that are accessible to the programmer.
- The internal registers include an accumulator and six 8-bit registers that can be paired as three 16-bit registers.
- In addition to general registers, a 16-bit stack-pointer, 16-bit program-counter, and two 16-bit index registers are provided.
- Control Unit
  - 8-bit Instruction decoder
- Arithmetic-Logic Unit
  - 8-bit arithmetic and logical operations
  - 16-bit arithmetic operations
  - Boolean manipulations
- Register File Unit
  - Duplicate set of both general purpose and flag registers
  - Two 16-bit index registers
- Interrupt Controller
  - Three modes of maskable interrupts
  - Non maskable interrupt
- External Memory interface
  - Can address up to 64 KB of program memory
  - Can address up to 64 KB of data memory
  - Can address up to 64 KB of input/output devices
- On-core dynamic memory refresh counter

## Functional Description

The CZ80CPU core is partitioned into modules as shown in the Block Diagram and described below.

### Cycle Control

The main control machine, which synchronizes all the others. It has an instruction register and all registers controlled interrupts, bus request cycle, wait states etc. This unit controls bus control signals too.

### Bus Control

Registers are triggered on the falling edge and or gates. These are used to form the bus control timing, changed on both clock edges. This is the only unit that has registers synchronized on the falling clock edge.

### Address Unit

This unit controls all operations on addresses (calculates the next instruction address, nested data address, jump and return address etc.) and increments and decrements the 16-bit addr register. It includes pc\_reg (program counter), sp\_reg (stack pointer), i\_reg (interrupt register) and r\_reg (refresh register).

### NMI Control

This unit detects a falling edge on the nmin pin. If detected, the internal nmi register is set and this causes a non-maskable interrupt service cycle.

### Reset Control

This unit controls the state of external signal resetn. If it has value '0' for at least three full clock cycles, then it sets the internal synchronous reset signal (rst) to '1.'

### Register Bank

This includes all the commonly used registers (based and alternative) and the logic element needed to change the data in these registers.

### Arithmetic-Logic Unit (ALU)

The unit accumulator and flag registers, and performs 8-bit arithmetic and logic operations, 16-bit arithmetic operations (without increment and decrement), bit operations, and sets the flag register.

## Implementation Results

The CZ80CPU is a technology independent design that can be implemented in a variety of process technologies. The following are typical Xilinx results with Fmax optimized for speed.

Family	Fmax (MHz)	Slices	IOB	GCLK	BRAM	MULT	DCM/DLL	MGT	PPC	Design Tools
Virtex-II Pro XC2VP4-7	78	2102	38	1	0	0	0	0	0	ISE 5.2i
Virtex-E XCV400E-8	45	2060	38	1	0	N/A	0	N/A	N/A	ISE 5.2i
Virtex-II XC2V500-6	76	2003	38	1	0	0	0	N/A	N/A	ISE 5.2i
Spartan-IIe XC2S300E-7	38	2388	38	1	0	N/A	0	N/A	N/A	ISE 5.2i
Spartan-3 XC3S400-4	36	1967	38	1	0	0	0	N/A	N/A	ISE 5.2i

## Support

The core as delivered is warranted against defects for ninety days from purchase. Thirty days of phone and email technical support are included, starting with the first interaction. Additional maintenance and support options are available.

## Verification

The CZ80CPU core's functionality was verified by means of a proprietary hardware modeler. The same stimulus was applied to a hardware model that contained the original Zilog Z84C00 chip, and the results compared with the core's simulation outputs.

## Deliverables

The core is available in ASIC (synthesizable HDL) and FPGA (netlist) forms, and includes everything required for successful implementation. The Xilinx version includes:

- Post-synthesis EDIF netlist
- Example CZ80CHIP – 8051 compatible design. This design uses the CZ80CPU and illustrates how to build and connect memories and port modules
- Sophisticated HDL Testbench that instantiates the example design CZ80CHIP, external RAM, external ROM, clock generator, and process that compares your simulation results with the expected results
- A collection of Z80 assembler programs which are executed directly by the Test Bench
- Simulation script, vectors, expected results, and comparison utility
- Place and route script
- Comprehensive user documentation, including architectural overview, hardware description, user guide, detailed specifications and a system integration guide